Low-frequency Kinetic Inductance in Graphene Films on SiO_2

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In the work real and imaginary components of impedance of single layer and multilayer graphene films on SiO_2 have been studied in the frequency range from 20 to 10^4 Hz. Structures of graphene/SiO_2/p-Si with SiO_2 thickness about 280 nm were used, and Ni contacts were deposited by dc magnetron sputtering on graphene film to fabricate transfer length (TL) method test structure (inset Fig.1(a)). Quality of the electrical contacts was studied by TL method at d.c. by Agilent 4156C precision semiconductor analyzer, and frequency dependences were studied by Agilent 4284A precision LRC meter. The measurements at a.c. were performed with both parallel RC and series RL equivalent circuit. It was shown that single layer and multilayer graphene structures demonstrate inductance properties at frequencies above $4x10^3$ Hz. Transition from capacitance behavior to inductance one depends on the film resistance (and consequently on measurement temperature). The increase of the graphene film resistance results in the increase of transition frequency (Fig.1). The value of inductance can be estimated as 10^{-7} H/μm that is considerably higher than reported in paper [1] (about 10^{-9} H/ μm).
The nature of such a phenomenon is considered on the basis of the model presented in [2] and equivalent circuit presented in Fig.2, where Rc is the contact resistance, R is resistance of graphene layer, C is the quantum capacitance, and L is the kinetic inductance. As it was demonstrated in [2] quantum capacitance and kinetic inductance for such circuits arise from the correct solution of Boltzmann transport equation. The effect of electron beam irradiation of the graphene layer on temperature dependence of resistance and kinetic inductance is studied.

References

[1] J. Chauhan, Jing Guo, Nano Res., **4** (2011) 571.
[2] S.Salahuddin, M.Lundsrom, S.Datta, IEEE Trans. Electron Dev., **52** (2005) 1734.

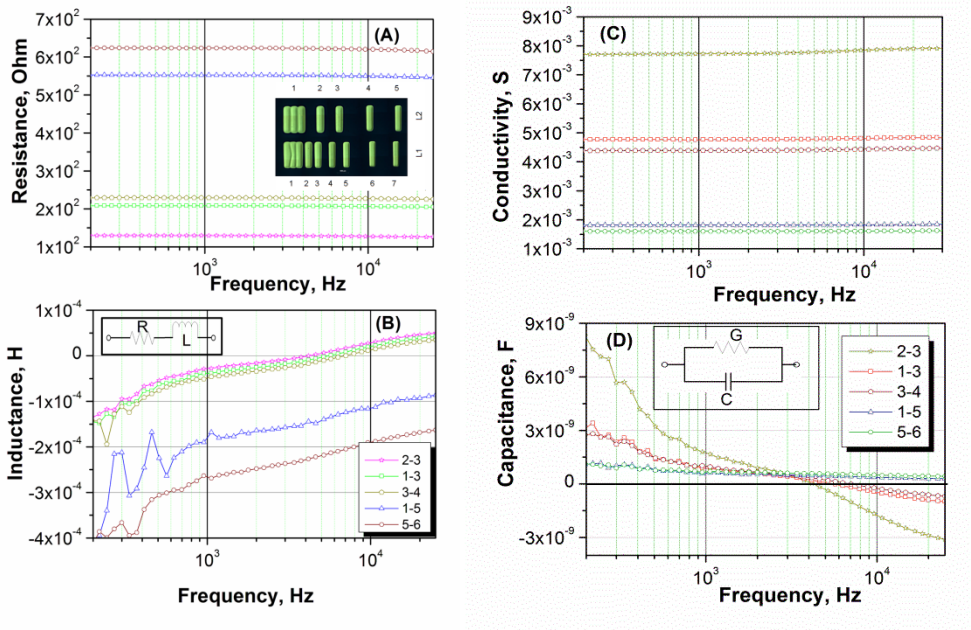

Fig.1

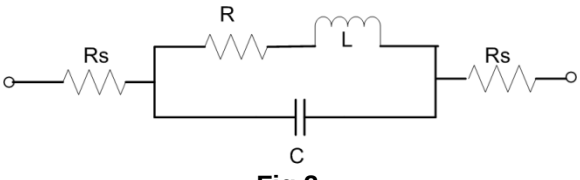

Fig.2